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## ABSTRACT

A large battery of various tests of intelligence, scholastic achievement, and short-term memory was administered to some 2,000 white, black, and Mexican American pupils in grades 4, 5, and 6 in a largely agricultural school district in the central valley of California; the 3 grades were used as separate replications. Factor analysis with oblique rotation yielded three main factors, identified as fluid intelligence, crystallized intelligence, and a memory factor. Mean factor scores for the three ethnic groups differed significantly. The white and black groups differed markedly in fluid and crystallized intelligence but not in memory; the white and Mexican American groups differed markedly in fluid, but much less in crystallized intelligence and memory. The black and Mexican American groups differed the most in fluid but only slightly in crystallized intelligence. There were also systematic ethnic group differences in the pattern of intercorrelations among factor scores, and in the correlations of the factor scores with an index of SES. The results are discussed in relation to Jensen's two-level theory of mental abilities and Cattell's theory of fluid and crystallized intelligence. (Author)

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Level I and Level II Abilities in  
Three Ethnic Groups

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ABSTRACT

A large battery of various tests of intelligence, scholastic achievement, and short-term memory was administered to some 2,000 white, Negro and Mexican-American pupils in grades 4, 5, and 6 in a largely agricultural school district in the central valley of California. The three grades were used as separate replications of the study. Factor analysis (i.e., principal components) with oblique rotation yielded three main factors, identified as fluid ( $\underline{g}_f$ ) and crystalized ( $\underline{g}_c$ ) intelligence (both are aspects of Level II ability in Jensen's theory) and a memory factor (a Level I ability). Mean factor scores for the three ethnic groups differed significantly and showed significant interactions with ethnicity largely in accord with expectations from Jensen's two-level theory of abilities. The white and Negro groups differed markedly in  $\underline{g}_c$  and  $\underline{g}_f$  but not in memory; the white and Mexican groups differed markedly in  $\underline{g}_c$ , and much less in  $\underline{g}_f$  and memory. The Negro and Mexican groups differed the most in  $\underline{g}_f$  but only slightly in  $\underline{g}_c$ . There were also systematic ethnic group differences in the pattern of intercorrelations among factor scores, and in the correlations of the factor scores with an index of socioeconomic status. The results are discussed in relation to Jensen's two-level theory of mental abilities and Cattell's theory of fluid and crystalized intelligence.

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Level I and Level II Abilities in  
Three Ethnic Groups<sup>1</sup>

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The two-level theory of mental abilities has been described in detail elsewhere (Jensen, 1968, 1970a, 1970b, 1973, pp. 196-293). Essentially, the theory posits a fundamental psychological distinction between two broad classes of mental abilities, called Level I and Level II. Level I involves the simple registration, storage, and recall of sensory inputs and is most prominent in short-term memory and rote learning. Individual differences in Level I ability have been measured by tests of short-term memory, such as digit span, and by paired-associate and serial rote learning, free recall of random familiar objects, pictures, or words, and trial-and-error selective learning. Level II involves mental manipulation of sensory inputs, relating them to stored memories, and generalization, abstraction, transfer, reasoning, conceptualization and problem solving. It is much like Spearman's *g*. Individual differences in Level II ability have been measured by standard tests of intelligence, especially tests of fluid intelligence, and by experimental conceptual learning tasks.

It has been hypothesized that Level I and Level II abilities have a distinct genetic basis, as well as being functionally interrelated in a hierarchical fashion such that Level II processes have some degree of

dependency upon Level I, but not the reverse. The functional dependence of Level II upon Level I, however, is probably only slight, in view of recent evidence (Jensen, in press). The correlation between Levels I and II in any given population is considered more a result of there existing a genetic correlation between the abilities which has come about through selection and assortative mating. Thus, theoretically almost any degree of correlation between the two kinds of abilities is possible, within the broad limits set by the rather low degree of functional dependence of Level II on Level I. Population groups that have developed under different selective pressures for different abilities, and through historic, geographic, and relative social isolation from one another, might therefore be expected to differ in Level I and Level II abilities and to show differences in the degree of correlation between Levels I and II.

Evidence from previous studies (reviewed in the references cited above) indicates that socioeconomic status (SES) and, to a greater extent, racial groups show differences in Level I and Level II abilities, and differences in the degree of correlation between Levels I and II. Briefly, SES and race (white-Negro) differences have been found to be markedly greater on Level II than on Level I abilities; and the correlation between Levels I and II is greater in middle SES than in low SES groups, and in the white than in the Negro population. While these relationships have been supported by a number of studies, their generality is not yet certain, and it is necessary to study them in a variety of different populations. Since all studies heretofore have been conducted in the highly urbanized white and Negro school populations of the greater Bay Area, in which there are especially marked SES contrasts between racial groups, the present study sought to determine if essentially the same relationships of Levels I and II to race

and SES showed up in a quite different school population, viz., an agricultural community in the central valley of California.

## Method

### Subjects

Some two thousand Ss constituting a representative sample of the school district's elementary school pupils were selected, with the classroom as the unit of selection, in such a way as to sample roughly equal numbers of the district's white, Negro, and Mexican-American pupils. The white population is mostly middle and lower middle class by most of the conventional criteria for SES classification. The Negro population is lower-middle and lower. The Mexican-Americans, with the exception of a very small percentage of middle and upper-middle class, is by far the most socio-economically disadvantaged as assessed by the usual criteria for SES. The median education of the Mexican-American parents is between 6 and 7 years, and many have had no formal education whatever. Most of the adult males are employed as field hands; many are itinerant crop pickers. Moreover, English is spoken exclusively in only about 16 percent of the Mexican-American homes in this district. By way of showing the average intellectual and SES characteristics of the three ethnic groups, Table 1 gives the Lorge-Thorndike Verbal and Nonverbal IQs and scores on Gough's Home Index, a measure of SES described in more detail in the following section. It can be seen that the white school population is very close to the national average in IQ, according to the Lorge-Thorndike Norms, with a mean  $IQ = 100$ ,  $\sigma = 16$ . The Negro group, as is typical of the general Negro population of California, is slightly but significantly above the national average for U.S. Negroes (about  $IQ\ 85$ ). No satisfactory nationwide normative data

exist for Mexican-Americans, but other studies, such as the large-scale Coleman report (Coleman, et al, 1966) typically find the Mexican-American mean located somewhere between the white and the Negro means on tests of scholastic aptitude, and this is what we see in Table 1. On the Home Index, an SES measure, the white and Mexican groups are separated, on average, by more than a standard deviation, and the Negroes are more or less intermediate.

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 Insert Table 1 about here  
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The Ns are somewhat smaller for the Home Index, since it became impossible to give all Ss this questionnaire because of protests in the community which arose after the testing was underway. It is doubtful that this misfortune introduced any systematic bias in the results on the Home Index. Most of the testing had been completed before the public protests against the use of the Home Index had been taken note of by the school administration.

### Tests

The Lorge-Thorndike Intelligence Test, Verbal and Nonverbal (Level 3, Form B) is a well-known standardized test of verbal and nonverbal intelligence. The reading level required by the verbal test is considerably below the reasoning demands made by the test items, so that reading ability per se accounts for less of the variance in grades 4 to 6 than is accounted for by

Table 1  
Mean Lorge-Thorndike Verbal IQ and Nonverbal IQ, and Mean Score  
on Gough's Home Index in Three Ethnic Groups

| Grade | Group   | N   | Verbal IQ |       | Nonverbal IQ |       | Home Index |       |      |
|-------|---------|-----|-----------|-------|--------------|-------|------------|-------|------|
|       |         |     | Mean      | SD    | Mean         | SD    | N          | Mean  | SD   |
| 4     | White   | 237 | 100.85    | 14.60 | 108.61       | 16.05 | 113        | 13.11 | 3.87 |
|       | Negro   | 189 | 88.03     | 11.27 | 92.33        | 14.20 | 129        | 11.64 | 3.12 |
|       | Mexican | 239 | 89.76     | 12.17 | 99.84        | 14.57 | 145        | 8.55  | 2.84 |
| 5     | White   | 242 | 101.83    | 13.87 | 110.07       | 14.93 | 144        | 14.09 | 3.88 |
|       | Negro   | 198 | 87.36     | 11.38 | 93.79        | 13.25 | 132        | 11.38 | 3.67 |
|       | Mexican | 211 | 89.65     | 13.11 | 99.47        | 14.77 | 135        | 9.50  | 3.20 |
| 6     | White   | 219 | 100.93    | 13.09 | 110.22       | 12.89 | 131        | 13.90 | 4.05 |
|       | Negro   | 169 | 90.35     | 12.58 | 97.99        | 14.64 | 124        | 12.00 | 3.17 |
|       | Mexican | 218 | 90.44     | 13.79 | 101.87       | 14.63 | 126        | 8.38  | 2.81 |

a g factor common to a variety of intelligence tests, both verbal and non-verbal. The Nonverbal test requires no reading and involves reasoning based entirely on figural materials, much like Cattell's Culture-Fair Tests of g.

The Lorge-Thorndike was always preceded by a short test of Speed and Persistence in which Ss make Xs in 300 printed squares for two periods of 90 seconds each, first without, and then with, motivating instructions to work as fast as possible. It serves as a warm-up for the Lorge-Thorndike which follows it immediately and it also serves to screen Ss who are not making an effort nor complying with the requirements of the testing situation.

Raven's Colored Progressive Matrices is a nonverbal reasoning test devised to measure the g factor and minimize variance on group factors and special abilities such as verbal and numerical ability. It is generally regarded as one of the most culture free or culture fair tests of reasoning ability. The test is administered without time limit, and Ss were encouraged to attempt every problem, with no penalty for guessing.

The Figure Copying Test, developed at Yale's Gesell Institute of Child Study, consists of ten geometric forms of regularly increasing complexity which the S must simply copy. There is one form per page of the 10-page test booklet; S is instructed to copy each form as nearly like the model as possible, attempting all figures without time limit. The test has been used as a measure of school readiness (Ilg and Ames, 1964), and in factor analyses it appears to be a rather purely g-loaded test. Each drawing is scored on a 3-point scale according to its approximation to the essential features of the model.

The Stanford Achievement Tests are a set of standardized tests of specific scholastic achievement appropriate for grades 4 to 6. The subtests

are Word Meaning, Paragraph Meaning (reading comprehension), Spelling, Language (grammar, punctuation, etc.), Arithmetic Computation, Arithmetic Concepts, and Arithmetic Applications.

Memory for Numbers is a set of three tests of auditory short-term memory, which has been found in past studies to be a good measure of Level I ability. The entire test, which takes about half an hour, is administered by means of a tape recording which presents digit series of from 4 to 9 digits at a one-second rate. After each series, the S writes as many digits as he can recall on a specially prepared answer sheet. The score is the number of digits recalled in the correct position. There are three scores, one for each subtest. The subtests consist of immediate recall, delayed recall (a 10-second interval is interposed between the presentation of the series and the time of writing the answer), and repeated series (each digit series is repeated three times prior to recall). The maximum score on any one of the subtests is 39, i.e., the sum of the digit series from four through nine.

The Memory for Numbers Test is always preceded by the Listening-Attention Test, given in the same voice by tape recorder. It makes no demands on memory but only on the ability to listen attentively and follow instructions. It serves both as a warm-up for the memory test and as a means of screening Ss who are not up to taking the memory test, for whatever reason. Virtually all children in regular classes in Grades 4 to 6 obtain near-perfect scores on the Listening-Attention Test. Also, each subtest of Memory for Numbers is preceded by an easy practice test of three-digit series which helps to insure that all Ss have understood the requirements of the test that immediately follows.

The Home Index is a 24-item questionnaire about the home environment (Gough, 1949, 1971). It is filled out by the child. The items are intended

to provide a sensitive composite index of the overall socioeconomic and cultural level of the child's family background. The items fall into four categories: Part I reflects primarily the educational level of the parents; Part II reflects material possessions in the home; Part III reflects the degree of parental participation in middle or upper-middle class social and civic activities; Part IV relates to formal exposure to music and other arts. One other item was added to the SES index, based on school records, viz., whether the child's family is on welfare. This dichotomous item had a significant and substantial correlation ( $-.40$ ) with the total score on the Home Index in the entire sample.

#### Procedure

All tests were administered in late Fall on different days for each test, but within a one-week period for any given class, with the exception of the Stanford Achievement Battery, which was administered within a one-week period in late Spring. Approximately half the sample (selected randomly with the classroom as the unit of selection) were tested by a staff of specially trained testers, and half were tested by their regular classroom teachers. Separate parallel analyses for testers and teachers were run on all the data, which were then combined for the present analyses, since they showed no systematic or significant differences with respect to the present variables.

#### Results

Since it would be most cumbersome to perform separate analyses on each test with respect to the hypotheses under consideration, it seemed

decidedly preferable to factor analyze the entire battery and work with a few main factor scores rather than with a large number of scores on various tests. Also, since the same tests were administered in Grades 4, 5, and 6, the three grade samples could be considered independent replications of each analysis and of the tests of the main hypotheses. Therefore data from the three grades were never combined for any analysis, but were treated as three independent replications of the study.

All the analyses were based on the raw scores, and age in months was partialled out of all the intercorrelations among the variables prior to the extraction of factor scores. Thus, none of the observed effects in any of the analyses can in any way be attributed to group differences or interactions of test variables with chronological age.

#### Oblique Factor Scores

Intercorrelations among all the ability and achievements tests within each racial group within each grade were subjected to a principal components analysis, and the components with eigenvalues greater than 1 were then rotated to oblique simple structure by means of the promax method (Hendrickson & White, 1964). The same three factors unambiguously emerge in each ethnic group and at each grade level, which justifies performing the same kind of analysis on the three ethnic groups combined within grade levels. Factor scores derived from the oblique factors for the combined ethnic groups permit group comparisons on each of the factors. Oblique rotation, of course, allows there to be correlated factors, and the factor structure which emerges is not artificially forced on the data. Three distinct factors emerged. Two of them must be regarded as types of Level II ability and the third as Level I.

The first two factors correspond closely to what Cattell (1971, Ch. 5) has referred to as crystalized and fluid intelligence, abbreviated as  $\underline{g}_c$  and  $\underline{g}_f$ , to represent these two aspects of the general intelligence factor,  $\underline{g}$ . Since these two factors in the present analysis are practically identical to Cattell's  $\underline{g}_c$  and  $\underline{g}_f$ , we will adopt these labels henceforth. Both, it should be noted, are Level II abilities. Level I ability is represented by the third factor which loads highly on the memory tests. Table 2 shows the oblique factor loadings.

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 Insert Table 2 about here  
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Factor scores were derived from the oblique factors for all  $\underline{S}$ s within each grade, and for each of the three factors the scores were standardized to a mean = 100,  $\sigma$  = 15.

Mean factor scores on  $\underline{g}_c$ ,  $\underline{g}_f$ , and Memory of the three ethnic groups in each of grades 4, 5, and 6 are shown in Figure 1. Analysis of variance within

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 Insert Figure 1 about here  
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each grade was used to test the significance of the main effects for ethnic groups and the interaction of groups and abilities; both the main effect and the interaction are significant beyond  $p < .001$ . On crystalized intelligence,  $\underline{g}_c$ , whites scored markedly higher than Negroes and Mexicans, who are similar

Table 2  
Oblique Factor Loadings<sup>1</sup> in Combined  
Ethnic Groups in Grades 4, 5, and 6

| Tests                        | Factor I                   |     |     | Factor II                  |     |     | Factor III |     |     |
|------------------------------|----------------------------|-----|-----|----------------------------|-----|-----|------------|-----|-----|
|                              | $\frac{g_c}{\text{Grade}}$ |     |     | $\frac{g_f}{\text{Grade}}$ |     |     | Memory     |     |     |
|                              | 4                          | 5   | 6   | 4                          | 5   | 6   | 4          | 5   | 6   |
| Lorge-Thorndike Verbal       | 64                         | 53  | 81  | 15                         | 16  | -05 | 04         | 10  | -02 |
| Lorge Thorndike Nonverbal    | 18                         | 16  | 32  | 62                         | 57  | 45  | 02         | 00  | 07  |
| Raven's Matrices             | -09                        | -08 | 06  | 93                         | 93  | 77  | -02        | -08 | -02 |
| Figure Copying               | -14                        | -15 | 13  | 91                         | 91  | 80  | -05        | 08  | -01 |
| Memory-Immediate             | -03                        | -02 | 05  | -03                        | -01 | -07 | 87         | 81  | 81  |
| Memory-Repeated              | 00                         | -05 | -03 | -06                        | -06 | -13 | 88         | 87  | 93  |
| Memory-Delayed               | -03                        | -06 | -07 | 04                         | 08  | 17  | 90         | 79  | 77  |
| Listening-Attention          | 09                         | 14  | -32 | 12                         | 10  | 08  | 08         | 08  | -03 |
| Making Xs, 1st Try           | 01                         | -03 | 04  | 03                         | -02 | -04 | 07         | 00  | -01 |
| Making Xs, 2nd Try           | 06                         | 01  | -01 | 07                         | 03  | -02 | -01        | -02 | 01  |
| <u>Stanford Achievement:</u> |                            |     |     |                            |     |     |            |     |     |
| Word Meaning                 | 91                         | 84  | 96  | -10                        | -14 | -13 | 04         | 13  | -04 |
| Paragraph Meaning            | 89                         | 95  | 96  | -07                        | -10 | -05 | -05        | -06 | -02 |
| Spelling                     | 95                         | 84  | 93  | -10                        | -09 | -20 | -11        | 06  | 01  |
| Language                     | 88                         | 69  | 82  | -02                        | 21  | 08  | 01         | 05  | 05  |
| Arithmetic Computation       | 50                         | 57  | 56  | 15                         | 04  | 22  | 07         | 03  | 05  |
| Arithmetic Concepts          | 65                         | 78  | 76  | 16                         | -01 | 14  | 04         | -15 | -02 |
| Arithmetic Applications      | 75                         | 76  | 81  | 07                         | 15  | 12  | 03         | -11 | -01 |

<sup>1</sup>Decimals omitted.

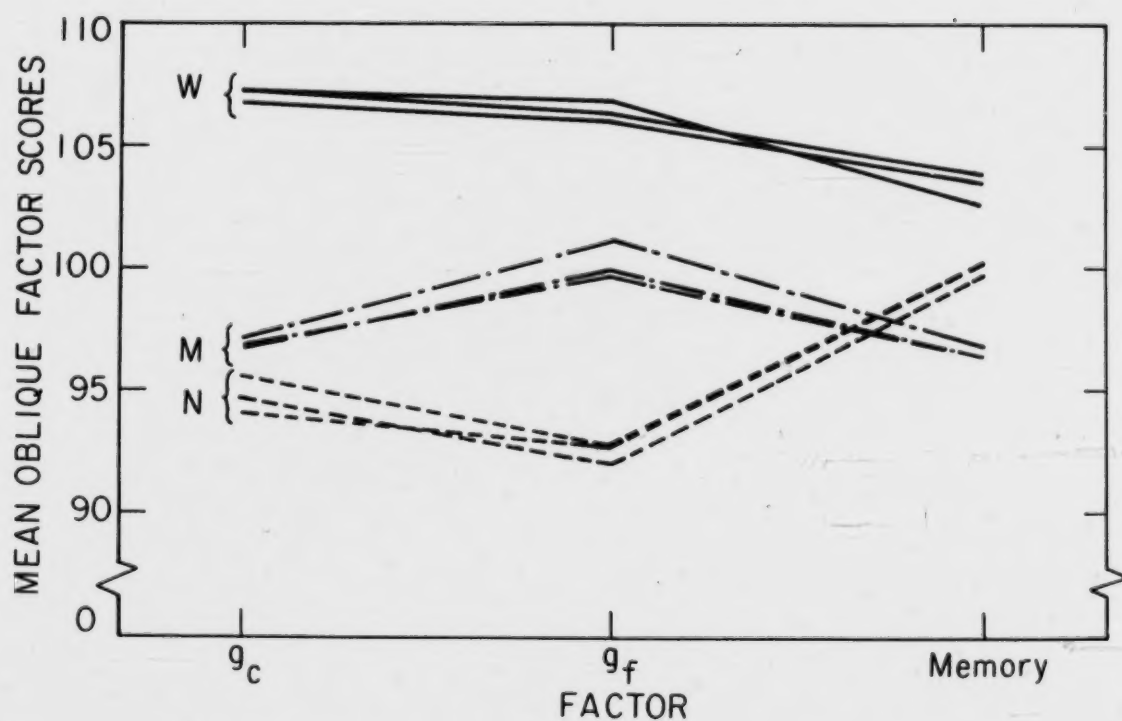


Figure 1. Mean oblique factor scores for crystalized intelligence ( $\underline{g_c}$ ), fluid intelligence ( $\underline{g_f}$ ), and memory in white (W), Negro (N), and Mexican (M) groups in Grades 4, 5, and 6. Grand mean = 100,  $\sigma = 15$  in each grade. The  $\underline{N}$ s in the various groups are given in the first column of Table 1.

in  $\underline{g_c}$ . On fluid intelligence,  $\underline{g_f}$ , whites and Negroes are even further apart, while Mexicans are intermediate. On Memory (Level I), the white and Mexican groups are furthest apart and Negroes are intermediate. In accord with previous findings, the Level II abilities (i.e.,  $\underline{g_c}$  and  $\underline{g_f}$ ) show much greater ethnic group differences (particularly white-Negro differences) than is found on Level I ability, in which the white and Negro groups come especially close together. As can be seen clearly in Figure 1, the pattern of factor scores for the three ethnic groups is closely replicated in every grade. Thus, the hypothesis that Level I and Level II abilities interact with population groups, and that low SES and middle SES groups differ more on Level II than on Level I, is borne out by these results, most clearly in the case of the white-Negro differences. The results of the Mexican group are less unequivocal with regard to the hypothesis, which suggests that the hypothesis applies more to the white-Negro racial difference rather than to their SES difference per se. The Mexican group is the most disadvantaged by a number of SES criteria, yet they differ from the white group on  $\underline{g_f}$  only half as much as does the Negro group; and  $\underline{g_f}$  is a more pure measure of Level II than  $\underline{g_c}$ . The lower scores of the Mexican group on the verbally loaded  $\underline{g_c}$  may be understood in large part in terms of their Spanish-speaking or bilingual home backgrounds. Whether their lower scores on the memory factor is related to language background is not known, but it should be noted that the three ethnic groups did not differ significantly on the Listening-Attention Test. It would be interesting to test for Level I in the visual modality as well as the auditory. The group means might have a different rank order with visually presented digits (see Jensen, 1970). This remains for future investigation.

### Orthogonal Factor Scores and Control of SES

In order to determine if the pattern of abilities for the three ethnic groups shown in Figure 1 is attributable more to SES than to ethnicity, variance on the Home Index (including welfare status) was partialled out of the matrix of correlations, which in effect statistically equates the ethnic groups on SES, in so far as SES is measured by the Home Index and welfare status. Also, the pattern of intercorrelations, and consequently the factor structure, is left unaffected by SES.

Further, in order to test the hypothesis with respect to independent, i.e., uncorrelated, factor scores, the three principal components were orthogonally rotated to the varimax criterion. The varimax factor scores, therefore, are free of the SES effects assessed in the Home Index, and, by virtue of their orthogonality, permit examination of the group differences on each factor when the ethnic groups have been statistically equated on each of the other two factors. In other words, we are asking how much the groups differ on each of the three factors independently of their differences on the other two. Figure 2 shows these results. We see that the picture is

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 Insert Figure 2 about here  
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highly similar to Figure 1, but all of the differences and similarities between groups on the various abilities appear somewhat sharpened or exaggerated, and they clearly replicate from one grade to another. Scheffé contrasts following the analysis of variance show no significant differences between whites and Mexicans on g<sub>f</sub> or between whites and Negroes on the memory factor. These

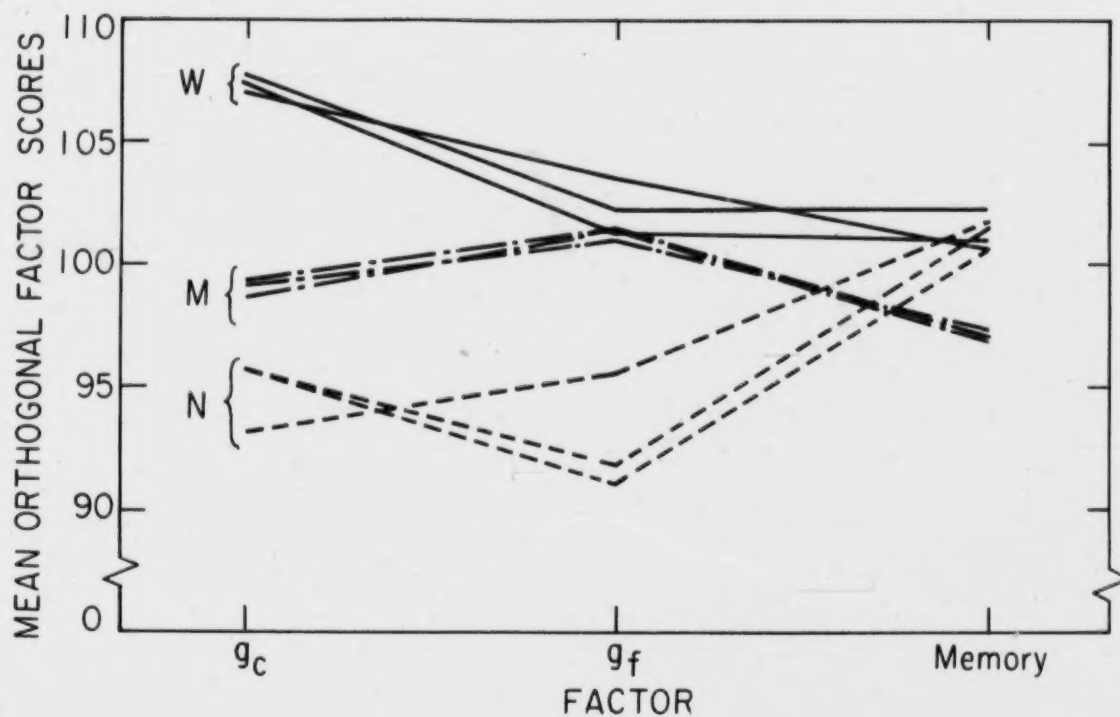


Figure 2. Mean orthogonal factor scores for crystallized intelligence ( $\underline{g_c}$ ), fluid intelligence ( $\underline{g_f}$ ), and memory in white (W), Negro (N), and Mexican (M) groups in Grades 4, 5, and 6, with SES (Gough's Home Index) statistically controlled. Grand mean = 100,  $\sigma = 15$  in each grade. The Ns in the various groups are given in the sixth column of Table 1.

results accord with the hypothesis for Negroes for both forms of Level II,  $\underline{g_c}$  and  $\underline{g_f}$ , but in the Mexican group the hypothesis holds only for  $\underline{g_c}$ . If we accept  $\underline{g_f}$  as the more pure and more culture-free measure of Level II, it would appear that the Mexican group differs hardly at all from the white group with respect to the hypothesis, despite the fact that it differs the most in cultural and SES background. Thus the interaction of Level I - Level II with population groups must be regarded as mainly a difference between whites and Negroes, rather than a difference in SES.

#### Correlations Between Oblique Factor Scores

Since the two-level theory of abilities posits essentially different and independent genotypic underpinnings for Levels I and II which may become genetically and phenotypically correlated through selection and functional interdependence of the two kinds of ability, a corollary of this is the possibility that the amount of correlation between Level I and Level II may differ in various populations which historically have differed in selection pressures, the basis for assortative mating, the degree of social and occupational stratification, and the like. Previous studies generally have found that the correlation between Level I and Level II tests is higher in the white than in the Negro population (Jensen, in press). There is evidence in earlier studies that the same correlational differences exist for middle and lower SES groups within a given ethnic group (e.g., Rapier, 1968), but more recent and larger investigations have made this conclusion doubtful or at least ambiguous (Jensen, in press; Green & Rohwer, 1971). Aside from whatever the causes of population differences in correlations may be, it is first of all important empirically to establish the authenticity of such differences.

The oblique factor scores should allow a good test of the hypothesized

population differences in correlations between Level I and Level II. Correlations (Pearson  $\underline{r}$ ) between the factor scores were obtained within each ethnic group within each grade. These  $\underline{r}$ s were transformed to Fisher's  $\underline{Z}_r = 0.5 \ln [(1 + \underline{r}) / (1 - \underline{r})]$  for testing the significance of the differences and for graphical presentation, as shown in Figure 3. (The untransformed Pearson  $\underline{r}$  can be read off the right-hand ordinate.)  $\underline{Z}_r$  is preferable for graphical presentation because, unlike Pearson  $\underline{r}$ ,  $\underline{Z}_r$  is an interval scale, so that differences in terms of  $\sigma_{\underline{Z}}$  units are directly comparable in different regions of the scale.

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 Insert Figure 3 about here  
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The pattern of correlations is highly consistent, with the one exception of the correlation between  $\underline{g}_f$  and memory in Grade 4. The only apparent explanation for this deviation is sampling error. In all other cases the pattern of correlations for whites and Negroes is consistent with previous findings, *viz.*, a higher correlation between Level II ( $\underline{g}_c$  and  $\underline{g}_f$ ) and Level I (memory) in the white group than in the Negro group. The correlations in the Mexican group are consistently more or less intermediate. Thus, in correlations as well as in mean scores, the Mexican group is less dissimilar from the white group than is the Negro group, despite the apparently greater cultural and socioeconomic disparity between the white and Mexican groups. A one-tailed statistical test of the correlational differences shown in Figure 3, based on the combined grades, shows significant white-Negro differences on  $\underline{g}_c \times \underline{g}_f$  ( $p < 10^{-6}$ ), and on  $\underline{g}_c \times \text{Memory}$  ( $p < .014$ ). The white-Mexican

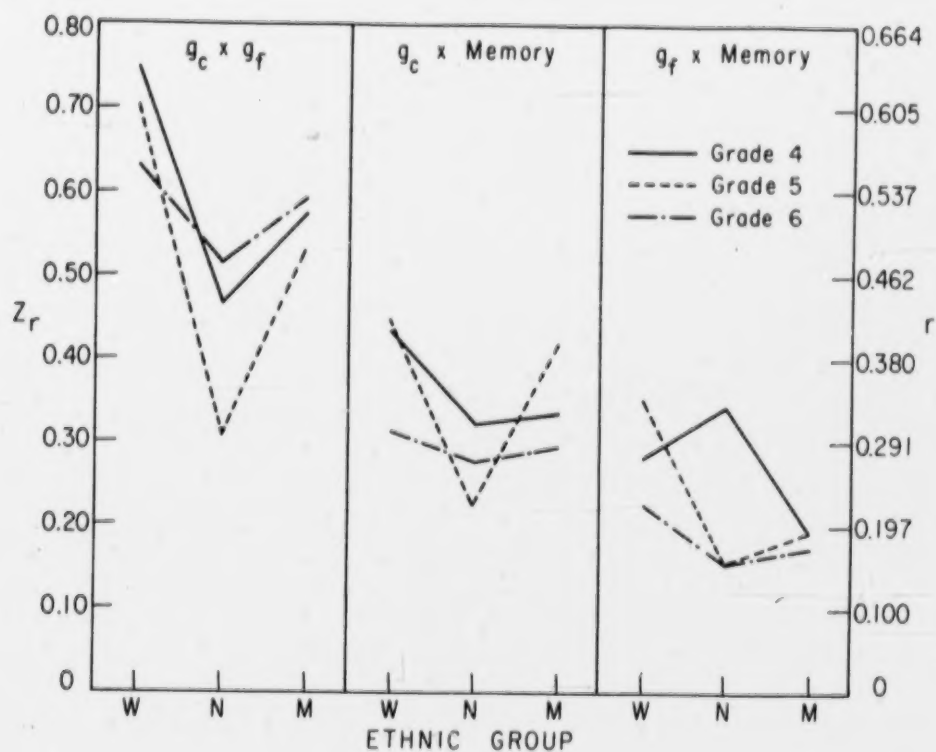


Figure 3. Fisher's  $\underline{Z_r}$  transformation of Pearson  $\underline{r}$  for correlations among oblique factor scores for fluid and crystalized intelligence ( $\underline{g_f}$  and  $\underline{g_c}$ ) and memory in white (W), Negro (N), and Mexican (M) groups at Grades 4, 5, and 6. The correlations are plotted on the transformed  $\underline{Z_r}$  scale so as to represent differences on an equal interval scale in terms of standard error units. The corresponding values of Pearson  $\underline{r}$  may be read off the ordinate on the right. The  $\underline{Ns}$  in the various groups are given in the sixth column of Table 1.

differences are significant only on  $\underline{g}_c \times \underline{g}_f$  ( $p < .01$ ) and  $\underline{g}_f \times \text{Memory}$  ( $p < .03$ ). The Mexican-Negro difference is significant only on  $\underline{g}_c \times \underline{g}_f$  ( $p < .01$ ).

The fact that the same ethnic pattern of correlations holds also for the correlation between  $\underline{g}_c$  and  $\underline{g}_f$  raises the question whether this correlational pattern is really a more general phenomenon, of which the two-level theory is merely one instance. Do Negroes show lower intercorrelations among various test scores in general than do whites, after taking account of test reliability and range-of-talent? A previous study which corrected for attenuation and range-of-talent still found highly significant differences between Level I and Level II tests. In the case of factor scores, however, there is no feasible method for determining reliability and, consequently, for correcting for attenuation. Prior analyses, however, revealed no significant or appreciable ethnic group differences in split-half and equivalent forms reliability of the various tests entering into the factor scores. Ethnic group differences in the degree of correlation among various traits in general is relatively unexplored territory. It would have implications for any kind of selection based on test results. Selection on the basis of one measured trait also means incidental selection on other correlated traits, and therefore, even with an identical selection cut-off across all populations, other criterion-relevant traits would differ in various populations that have different patterns of intercorrelations of the various traits. For example, from Figure 3 it is evident that selection on  $\underline{g}_c$  would pull along with it a higher degree of incidental selection on  $\underline{g}_f$  in the white group than in the Negro group. Fair assessments of individuals from various populations would therefore seem to depend upon the use of multiple selection criteria and a broad inventory of measured abilities.

### Relationship of Factor Scores to SES Within Ethnic Groups

Past accounts of the two-level theory have posited a lower correlation of SES with Level I than with Level II. Just as the white-Negro difference is less for Level I than for Level II, it was hypothesized that the difference between lower and higher SES groups is less for Level I than for Level II. Rapier (1968) presented evidence for this interaction of SES and Levels I and II within a white population. Green and Rohwer (1971), however, reported findings which appear equivocal regarding the predicted interaction within a Negro sample divided into Lower, Lower Middle, and Middle SES. The predicted interaction showed up for one Level I test (paired-associates learning), but not for another (digit span), which showed just as large SES differences as a Level II test (Raven's Matrices). Jensen (in press), on the other hand, found high and low SES groups to differ almost twice as much on a Level II test (Lorge-Thorndike IQ) as on a Level I test (Memory for Numbers), both in white and Negro populations, when these were stratified into three SES groups on the basis of parent's occupation.

The question can be investigated with the present data simply by correlating the oblique factor scores with the Home Index within each ethnic group. Since previously cited studies suggest that the ability scores do not have a linear regression on SES, it is advisable to measure the degree of relationship between factor scores and the Home Index by means of the correlation ratio,  $\eta$ , which can reveal nonlinear as well as linear regression of the factor scores on the SES index. The obtained values of  $\eta$  are given in Table 3.

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 Insert Table 3 about here  
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Table 3

Correlation Ratio (Eta) of Oblique Factor Scores on Gough's Home Index  
in White (W), Negro (N), and Mexican (M) Groups

| Grade    | <u><math>\underline{g_c}</math></u> |      |      | <u><math>\underline{g_f}</math></u> |      |      | Memory |      |      |
|----------|-------------------------------------|------|------|-------------------------------------|------|------|--------|------|------|
|          | W                                   | N    | M    | W                                   | N    | M    | W      | N    | M    |
| 4        | .387                                | .187 | .185 | .455                                | .315 | .119 | .225   | .235 | .153 |
| 5        | .422                                | .216 | .277 | .530                                | .193 | .124 | .232   | .238 | .141 |
| 6        | .294                                | .187 | .335 | .501                                | .165 | .193 | .164   | .138 | .261 |
| Combined | .377                                | .197 | .269 | .498                                | .225 | .144 | .209   | .211 | .193 |

We see that the  $\eta$ s are all rather surprisingly low, except for  $\underline{g_c}$  and  $\underline{g_f}$  in the white group. Also, one might have expected a higher correlation for  $\underline{g_c}$  than for  $\underline{g_f}$ , but just the reverse was found. As for our hypothesis that Level II should be more highly related to SES than Level I, we find consistent and significant evidence in support of the hypothesis only in the white group, in which the correlation of both  $\underline{g_f}$  and  $\underline{g_c}$  with SES differs significantly ( $p < .01$ ) from the correlation of Memory with SES. In the Negro and Mexican groups the hypothesized interaction of Levels I and II with SES is not consistently borne out and the effects are nonsignificant ( $p > .05$ ) in all cases.

#### Discussion

This study, using a different methodology based on factor scores, clearly replicates the main findings of previous studies with regard to white-Negro mean differences in Level I and Level II abilities and the interaction of abilities  $\times$  race. The predicted pattern of correlations between Levels I and II, viz., a higher correlation in the white than in the Negro population, was also borne out, although not as impressively. Finally, consistent and significantly different correlations of Levels I and II with SES were found only in the white group. The Negro and Mexican groups evinced surprising rather uniformly low correlations of all three of the ability factors and the measure of SES. This disparity in SES correlations in the white group on the one hand, and in the Negro and Mexican groups on the other, is not attributable to ethnic group differences in variances or reliabilities of the Home Index. It is more likely due to differential validity of the Index in the three groups, at least as regards correlations

of SES and ability. Variation in the below-average range of the Home Index, where the vast majority of Negroes and Mexicans are distributed, may be less highly related to ability differences than variation in the above-average range, where a substantial proportion of the white population is found. A highly detailed examination of the relationship of the Home Index to aptitudes and achievement in the three ethnic groups, using multiple regression analyses, is planned as a separate study.

The inclusion of the Mexican group in the present study adds to the evidence that Level I-Level II interacts more with white-Negro differences than with SES per se, since the Mexican group, which is culturally and socioeconomically the more different from the white group, actually differs less from the white group on the Level II measures, especially  $\underline{g}_f$ , than does the Negro group. The same is true of the correlations between abilities, especially  $\underline{g}_c \times \underline{g}_f$ .

Since the two-level theory essentially hypothesizes independence of Level I and Level II abilities, which become correlated at the genotypic level through genetic selection and at the phenotypic level through some degree of functional interdependence (especially the dependence of some types of Level II performance upon Level I processes), it is fully consistent with the theory to find different degrees of correlations between Levels I and II and different patterns of mean differences in various populations.

It is important to distinguish between the essential aspects of the theory, viz., the independence of Levels I and II, and the empirical manifestations of the theory in various populations. The validity of the theory, on the one hand, and the generality of certain population differences in Levels I and II, on the other, are essentially different questions, in the same way that the law of falling bodies and the particular value of the

gravitational constant are separate questions. The present study supports the essential two-level theory in so far as it demonstrates population differences (both in means and intercorrelations) in the two classes of ability, and it further substantiates the empirical findings of other studies regarding the white-Negro interaction with Levels I and II.

The two-level theory is not at all in conflict with Cattell's (1971) theory of fluid and crystalized intelligence, but, in a sense, is actually "orthogonal" to it. Fluid and crystalized abilities can be either Level I or Level II. For example,  $\underline{g}_c$  and  $\underline{g}_f$  are both Level II abilities in the two-level theory, and the present Memory factor and the  $\underline{g}_f$  factor are both fluid abilities in Cattell's theory. Both theoretical distinctions, Level I-Level II and fluid-crystalized, seem conceptually valid and are consistent with empirical findings.

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